Fishery Data Series No. 10-30

2009 NSEI (Northern Southeast Inside Subdistrict) Sablefish Mark-Tag Survey

by

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and

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April 2010

Alaska Department of Fish and Game **Divisions of Sport Fish and Commercial Fisheries**

Symbols and Abbreviations

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Weights and measures (metric)

centimeter	cm
deciliter	dL
gram	g
hectare	ha
kilogram	kg
kilometer	km
liter	L
meter	m
milliliter	mL
millimeter	mm

Weights and measures (English)

cubic feet per second	ft^3/s
foot	ft
gallon	gal
inch	in
mile	mi
nautical mile	nmi
ounce	oz
pound	lb
quart	qt
yard	yd

Time and temperature

day	d
degrees Celsius	°C
degrees Fahrenheit	°F
degrees kelvin	K
hour	h
minute	min
second	s

Physics and chemistry

all atomic symbols	
alternating current	AC
ampere	A
calorie	cal
direct current	DC
hertz	Hz
horsepower	hp
hydrogen ion activity (negative log of)	pH
parts per million	ppm
parts per thousand	ppt, ‰
volts	V
watts	W

General

Alaska Administrative Code	AAC
all commonly accepted abbreviations	e.g., Mr., Mrs., AM, PM, etc.
all commonly accepted professional titles	e.g., Dr., Ph.D., R.N., etc.
at	@
compass directions:	
east	E
north	N
south	S
west	W
copyright	©
corporate suffixes:	
Company	Co.
Corporation	Corp.
Incorporated	Inc.
Limited	Ltd.
District of Columbia	D.C.
et alii (and others)	et al.
et cetera (and so forth)	etc.
exempli gratia (for example)	e.g.
Federal Information Code	FIC
id est (that is)	i.e.
latitude or longitude	lat. or long.
monetary symbols (U.S.)	$, ¢
months (tables and figures): first three letters	Jan,...,Dec
registered trademark	®
trademark	™
United States (adjective)	U.S.
United States of America (noun)	USA
U.S.C.	United States Code
U.S. state	use two-letter abbreviations (e.g., AK, WA)

Measures (fisheries)

fork length	FL
mideye to fork	MEF
mideye to tail fork	METF
standard length	SL
total length	TL

Mathematics, statistics

all standard mathematical signs, symbols and abbreviations	
alternate hypothesis	H_A
base of natural logarithm	*e*
catch per unit effort	CPUE
coefficient of variation	CV
common test statistics	(F, t, χ^2, etc.)
confidence interval	CI
correlation coefficient (multiple)	R
correlation coefficient (simple)	r
covariance	cov
degree (angular)	°
degrees of freedom	df
expected value	*E*
greater than	>
greater than or equal to	≥
harvest per unit effort	HPUE
less than	<
less than or equal to	≤
logarithm (natural)	ln
logarithm (base 10)	log
logarithm (specify base)	$\log_2$, etc.
minute (angular)	'
not significant	NS
null hypothesis	H_O
percent	%
probability	P
probability of a type I error (rejection of the null hypothesis when true)	α
probability of a type II error (acceptance of the null hypothesis when false)	β
second (angular)	"
standard deviation	SD
standard error	SE
variance	
population	Var
sample	var

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ABSTRACT

The Alaska Department of Fish and Game (ADF&G) manages the Northern Southeast Inside (NSEI) Subdistrict sablefish (*Anoplopoma fimbria*) fishery in Southeast Alaska. Mark-recapture methods are used to estimate abundance of this resource. In 2009 longlined pot gear was set to catch sablefish in the NSEI management area, which includes the waters of Chatham Strait and Frederick Sound. Forty sets were made with a total of 1,679 pots hauled to capture 9,772 sablefish. Healthy sablefish greater than 320 mm were tagged, finclipped, and released. A total of 7,071 sablefish were tagged, and tags were successfully distributed within and among statistical areas in similar proportion to the average 2006–2008 commercial harvest and in proportion to the depth of the 2006–2008 commercial harvest. Every 12th sablefish was retained as a biological sample, and otoliths, length, sex, and maturity state were collected. A total of 706 biological samples were collected. In addition, temperature data were collected to determine the range of values sablefish were exposed to during the survey.

Key words: Sablefish, black cod, *Anoplopoma fimbria*, Southeast Alaska, Northern Southeast Inside, NSEI, Chatham Strait, Frederick Sound, tagging, mark-recapture.

INTRODUCTION

Sablefish (*Anoplopoma fimbria*) is one of the most commercially important species in Southeast Alaska. The Northern Southeast Alaska Inside (NSEI) longline fishery occurs in the deep water fjords of Chatham Strait (between 58°19′N and 56°10′N latitude) and in Frederick Sound (approximately 134°25′W, 56°51′N to 133°54′W, 57°22′N; Figure 1). During the 2009 commercial fishery, the average price paid per round pound of sablefish was $3.34 ($7.35 per kg) and per dressed pound was $5.29 ($11.67 per kg); the total ex-vessel value was $3.5 million. Sablefish are a long-lived species with a maximum reported age of 79 years in Southeast Alaska, and with 40-year old fish commonly occurring in NSEI commercial harvests (K. Munk, ADF&G, Division of Commercial Fisheries, Juneau *personal communication*). Careful management of the NSEI commercial fishery is necessary to ensure sustainability of this highly-valued resource.

ADF&G manages the NSEI sablefish commercial fishery by setting annual harvest quotas based on abundance estimates determined from mark-recapture methods. A survey is performed annually to tag and finclip sablefish and is referred to as the marking portion of the study; the recapture portion occurs from port sampling sablefish landed by the NSEI sablefish longline fishery. Mark and recapture data collected for a particular year is used to set the annual harvest quota for the following year along with consideration of other years of data.

The survey goal was to mark sablefish among statistical areas in proportion to sablefish population abundance; however, sablefish abundance by statistical area was unknown. Consequently, fish were marked among statistical areas in proportion to commercial fishing harvest based on the assumption that population abundance was proportional to commercial harvest (Dressel 2009). During past mark-tag surveys, sablefish have been marked throughout the NSEI Subdistrict in proportion to the commercial harvest by statistical area for the prior year. In 2009, sablefish were marked in proportion to the average commercial harvest by statistical area for the 3 previous years. Use of the 3 previous years of commercial harvest data began in order to best distribute marks with possible harvest patterns of the upcoming fishery. Another change occurred during the 2009 mark-tag survey; sablefish were marked in proportion to the depths fish were harvested during the 2006 to 2008 commercial harvests. Prior to the 2009 survey, sablefish were marked in proportion to the depth fish were commercially harvested during the previous year only.

For mark recovery, port samplers observe the majority of NSEI longline sablefish landed in the ports of Sitka, Juneau, and Petersburg. Fish are carefully examined for tail clips, and the total number of fish with and without tail clips, along with marking information is used to determine a Petersen estimate of abundance. The sablefish mark-tag survey occurs during June, ending approximately a month and a half before the NSEI longline fishery begins on August 15. This time frame was chosen to allow adequate mixing of marked and unmarked fish within Chatham Strait while minimizing fish movement in and out of Chatham Strait between the mark and recapture phases of the study.

Sablefish have been tagged and/or finclipped in the NSEI Subdistrict since 1997. In 2004 sablefish were given Passive Integrated Transponder (PIT) tags and in all other years sablefish were tagged with floy tags. From 1997 to 1999 sablefish were tagged and/or marked during the annual longline survey; catch per unit effort and biological data were also collected during this annual survey. The pattern of recaptures by the longline fishery in 1997 and 1998 indicate that fish were gear shy due to their initial capture by longline gear for marking (Carlile et al. 2002). As a consequence, in 1999 no marking or recapture phase occurred; however, fish were still captured with longline gear and tagged on the 1999 survey. In 2000, both the mark and recapture phases of the project were reinstated and capture of sablefish for marking shifted to longlined pots. An annual longline survey to collect catch per unit effort and biological data was continued but now conducted separately from the mark-tag survey. Pot dimensions for the 2000 survey are unknown. In 2001 both 1.5 m (5 ft) and 1.8 m (6 ft) cone-shaped pots were used; since 2002, only 1.5 m (5 ft) cone-shaped pots have been used to capture sablefish on the survey (Richardson 2001; Richardson 2002; Richardson 2003; O'Connell and Holum 2007; Stahl and Holum 2008; ADF&G *unpublished reports*). The annual survey also provides tagging and biological information used to study sablefish movement and biological parameters.

This report summarizes the survey tagging and biological collection activities from the 2009 NSEI sablefish mark-tag survey. The results of the 2009 mark-recapture experiment including the population abundance estimate will not be presented in this report.

OBJECTIVES

1. Capture, tag, finclip, and release at least 7,000 sablefish greater than 320 mm in order to estimate population abundance based on a Petersen mark-recapture estimate.
2. Capture, measure, and release any sablefish 320 mm or smaller.
3. Mark and tag sablefish among statistical areas in proportion to the average of the 2006–2008 NSEI commercial harvest by statistical area.
4. Mark and tag sablefish throughout statistical areas to insure complete mixing.
5. Mark and tag sablefish by depth in proportion to the 2006–2008 NSEI commercial harvest by depth.
6. Collect biological samples from the total size distribution of sablefish captured.
7. Record temperatures that sablefish are exposed to during capture and handling.

METHODS

OPERATIONS

The survey was performed in statistical areas where at least 2% of the average NSEI 2006 to 2008 sablefish longline fishery harvest occurred (Table 1). In 2009 statistical area 335701 in Frederick Sound was not sampled as had been done in previous years, because this statistical area accounted for less than 2% of the 2006 to 2008 catch. The R/V *Zolotoi*, a 31 m (101 ft) research vessel, was chartered to conduct the sablefish mark-tag survey from May 31, 2008 through June 25, 2008. Contract costs were $127,500 and included fuel, food, bait, and all fishing gear. Vessel crew and scientific staff are listed in Appendix A.

Survey gear was used to capture live sablefish and consisted of pots attached to a longline to make a string or set. Pots were cone-shaped with a 1.5 m (5 ft) diameter and 2 opposing tunnels. Each set included about 42 pots with approximately 73 m (240 ft) of line between each pot. Chopped bait was placed in a bait bag inside each pot. The bait mixture consisted of ½ squid and ½ pollock. A total of 10 lbs of bait was placed in each pot with 6 lbs chopped and 4 lbs hanging. In general, 2 pot strings were set and hauled per day. Pots were soaked for 5 to 50 hours. Soak time was adjusted dependent on the vessel operating schedule, distance between sets, and the history of "sand flea" (Order Amphipoda) abundance in an area; in locations with a history of high "sand flea" abundance, the soak time was minimized to prevent sablefish mortalities. Captured sablefish and bycatch were released from each pot into a live well consisting of 3 temporary holding tanks.

DATA COLLECTION

Sablefish greater than 320 mm were finclipped, tagged, and released. Fish were tagged dorsally using orange T-bar tags numbered between 035030 and 043019. Tagged fish were also marked with a finclip on the upper lobe of their caudal fin (Figure 2) and sampled for length.

Fish were not tagged or finclipped if they were 320 mm or less or if they were determined to have reduced survival ability due to flea bites, injuries, or a lack of vigor. All discarded and released fish were measured for fork length.

Biological samples were collected from the entire size distribution of fish captured. Otoliths, length, sex, and a maturity state were sampled from the first fish of every pot string and every 12^{th} fish thereafter. Maturity state was determined by macroscopic visual examination of the gonads according to a 6-stage scale (Table 2).

Fish that were previously tagged with an ADF&G tag and were in good health were released after recording the tag number and fork length (to the nearest cm). Fish that were captured that were previously tagged but were not in good health or dead, were retained and sampled for length. Fish that were previously tagged by an agency other than ADF&G were retained or released dependent on the instructions of that agency (see 2009 pot survey standard operating procedures for details).

Bycatch was identified and counted by species. Bycatch from the genus *Sebastes* generally exhibited visible signs of barotrauma, so they were retained unless there was time to attempt to release them at depth. Other bycatch species, including shortspine thornyhead rockfish (*Sebastolobus alascanus*), which do not show visible signs of barotrauma, were released.

The release of rockfish of the genus *Sebastes* was attempted if this procedure did not interfere with the timely release of sablefish. Cannonball weights, hand line, and Shelton Fish Descender™ (SFD)[1] were used in order to release rockfish at depth. The SFD is an "S"-shaped hook designed specifically for rockfish recompression at depth and to ensure that oxygenated water moves over the fish's gills. A piece of hand line was tied to the SFD hook at the attachment point furthest from the barb end and weighted on the other end with one or more 2 to 10 lb cannon balls. An additional section of line was tied to the SFD hook at the attachment site closest to the barb and then secured to the vessel on the other end. To recompress a fish, the SFD hook was inserted through the thin membrane of the lower lip, starting from the inside of the mouth. The fish was slowly lowered to the surface of the water off the stern of the vessel using the portion of the hand line secured to the vessel; slack was provided in line to prevent the premature release of the rockfish. The weighted line was kept on the deck until the fish landed at the water's surface, then the cannon balls were dropped overboard. After line attached to the weights was played out, a hard tug was performed in order to release the rockfish from the SFD. Line was retrieved by hand after the rockfish was free of the SFD.

Sablefish captured during the NSEI mark-tag survey may be vulnerable to delayed mortality unless exposure to elevated holding tank temperatures and handling time are limited. Delayed mortality or immunological suppression was observed in experiments where capture of sablefish was simulated with gear (hook or trawl) contact and elevated air and/or water temperature exposure of 15 minutes or more (Davis et al. 2001; Davis 2005; Lupes et al. 2006). As a consequence, we monitored and recorded the temperatures that sablefish were exposed to during capture and handling, including surface, bottom, and holding tank temperatures. TidbiT® v2 Temp Loggers were used to record bottom temperature, date, and time at 30 minute intervals. TidbiT® v2 Temp Loggers were attached to 2 pots in a string, one at each end of the set, and deployed each time the gear was set. When the gear was hauled, the pot each TidbiT® v2 Temp Logger was located on was recorded. Surface temperature was recorded by a TidbiT® v2 Temp Logger at 30 minute intervals placed in the water at the stern of the vessel during each haul. Holding tank temperature was measured in center and right holding tanks using a digital water resistant thermometer, or using a TidbiT® v2 Temp Logger if the thermometer battery died. This information was recorded at the beginning, middle, and end of each haul, along with time, and weather conditions.

Duration of exposure of captured sablefish to elevated water temperature of the holding tank and air temperature were determined. When time allowed, the following data was collected for particular pots in some sets: time required to process fish, number of sablefish tagged, number discarded, number previously tagged, and number biosampled.

SAMPLE DESIGN

The target tagging goal was set at 7,000 sablefish. Sablefish were marked and tagged among statistical areas in proportion to the average 2006 to 2008 commercial harvest from each area based on the target tagging goal set (Table 1; Table 3). Once the approximate quota was reached for a statistical area, the next statistical area was sampled. If the quota was reached in the middle of a set and a large quantity of fish were left in the pots, sablefish in the remaining pots were estimated and released without marking, tagging, or sampling.

[1] Product names used in this report are included for scientific completeness, but do not constitute a product endorsement.

In addition, sablefish marks and tags were distributed by depth in proportion to the 2006 to 2008 NSEI commercial harvest by depth in each statistical area (Table 1; Table 3). Depths ranging from 50 to 480 fathoms were considered for set placement. However, meeting the tagging goal for a particular statistical area was considered a priority over tagging and marking fish from depths where only a small proportion of the 2006 to 2008 commercial harvest occurred.

In order to distribute marked/tagged fish throughout a statistical area, no overlapping sets were performed within a statistical area, and sets were performed both over the latitudinal and longitudinal range of a statistical area.

Another consideration to set placement was the marking history of an area. Numbers of sablefish captured, tagged, and marked during previous mark-tag surveys were used to help determine placement of sets. In addition, placement of survey gear was avoided at established set locations for the NSEI longline survey.

DATA ANALYSIS

In order to determine the range of temperatures sablefish were exposed to, the bottom, surface, and holding temperatures were graphed by date. For bottom temperature, date and temperature were graphed for each recording that occurred within the time frame of a set and when the TidbiT® v2 Temp Logger was located on the ocean floor (an obvious jump in temperature occurs when the pot is not on the bottom). For the surface temperature, date and temperature from the surface TidbiT® v2 Temp Loggers were graphed for each set within the time frame the TidbiT® v2 Temp Logger was deployed and retrieved. For the holding tank temperature, only the center holding tank temperature and date were graphed. The right holding tank was not used to hold sablefish, so this tank was not flushed and the water flow was not maintained. The middle and right holding tanks had similar temperatures, so only the center holding tank was graphed for simplicity.

RESULTS AND DISCUSSION

SCHEDULE

The 2009 NSEI mark-tag survey occurred from June 1 to 23. The R/V *Zolotoi* left Sitka on June 1, and the crew set the first gear on that same day. During most days of the survey, 2 strings of gear were set, and the 2 strings of gear set the previous day were hauled (Appendix B). Around the end of the survey (June 20 to 23) only one string of gear was set per day and the gear was either hauled the following day or the same day as the gear was set. The overall tagging goal was raised during the second half of the survey after high catches of sablefish were consistently experienced. Consequently, additional fish were needed in a few areas to meet the new goals for each statistical area. Some of these sets were far apart; as a result, only one pot string was set on some days.

The survey began in central Chatham Strait near the entrance to Peril Strait and moved northward to north of the entrance to Icy Strait; sets 1 to 5 were made on June 1 to 3 in statistical areas 345701 (northern tip), 345731, and 345803. Sets 6 to 18 were then set from northern Chatham Strait in a southerly direction south to Gut Bay on June 3 to 9 (statistical areas 345803, 345731, 345701, and 345631). Sets 19 to 22 were set in Frederick Sound (statistical area 345702) on June 10–11. The R/V *Zolotoi* was docked in Petersburg June 11 to 12 and left port at 11:00 pm on June 12; additional bait and supplies were obtained and the crews were switched

while in Petersburg. The vessel returned to Frederick Sound and hauled sets 21 and 22 and sets 23 and 24 on June 13. One last set was made in Frederick Sound on June 14 (set 25). Sets 26 to 34 were performed in the southern end of Chatham Strait from June 14 to 18 (statistical areas 345631 and 345603) and were set in a southward direction (Figure 1). Sets 35 to 40 were made June 19 to 23 in the northward direction (345631, 345701, 345731, and 345803). The survey was completed in statistical area 345731 on June 23.

SET INFORMATION

A total of 1,680 pots were deployed with 1,679 pots successfully recovered in 40 sets during the 2009 NSEI mark-tag survey. The sets were made in depths from 155 to 481 fathoms. Soak time averaged 21.4 hours and ranged from 5 to 50 hours. Sets 21 and 22 soaked for over 46 hours while the crew travelled to and back from Petersburg. Haul time averaged 1.8 hours and ranged from 0.9 to 2.6 hours (Appendix B).

CATCH AND TAGGING INFORMATION

At least 10 different species of fish and one species of commercially important crab were caught during the survey in 2009 (Appendix C); a total of 12,515 individual fish or commercially important crab species were caught. Sablefish was the dominant species of fish caught, followed by arrowtooth flounder (*Atheresthes stomias*), Dover sole (*Microstomus pacificus*), Pacific halibut (*Hippoglossus stenolepis*), and rougheye rockfish (*Sebastes aleutianus*) (Appendix D). A total of 9 fish were not identifiable due to sand flea damage. A total of 193 golden king (brown) crab (*Lithodes aequispina*) were captured and identified. In addition, numerous other invertebrates were entangled or captured in the pot gear; the following are some of the organisms observed; however, this list is not exhaustive: coral (*Primnoa pacifica*); basket and brittle stars (Class Ophiuroidea), mud stars (*Ctenodiscus crispatus*), heart urchins (*Brisaster latifrons*), hermit crabs (Superfamily Paguroidea), and tritons (*Charonia* sp.).

A total of 9,772 sablefish were caught during the 2009 survey; 7,071 of these fish were tagged, finclipped, and released (Appendix E). Two fish were released with only a clip due to the tag falling out as the fish exited the vessel, and one fish was tagged but not clipped. No sablefish were captured below the minimum tagging size of 320 mm. The catch included 98 fish previously tagged by ADF&G that were re-released with their original tag; 7 of these fish were tagged during the 2009 survey. In addition, 2 fish were captured that were previously tagged by the Department of Fisheries and Oceans (DFO) in Canada. These fish were retained, biological information was collected, and the tag and otoliths were returned to DFO. A total of 706 sablefish were retained for biological sampling. An additional 452 sablefish were captured and then discarded or released without tagging because they were dead or not healthy due to sand flea damage or other injuries, such as pot abrasions or a torn mouth. In addition, an estimated 1,441 sablefish were released without tagging because the quota was reached for an area or in the case of set 30, an invalid set was made. For set 30 the gear was intended to be set in the lower end of statistical area 345631; however, the majority of the set drifted into statistical area 345603. As a consequence, all pots were dumped and the number of sablefish released was estimated.

The overall target tagging goal of 7,000 sablefish was met in 2009, and the tagging goals for each statistical area were met as well. In addition, tags and marks were distributed consistent with the average proportion of the 2006 to 2008 harvest by statistical area; the difference between percent tagged in a statistical area and percent of the average 2006 to 2008 harvest in

that area was 1% or less (Table 4). Initially a tagging goal of 6000 sablefish was set based on catch history of past surveys. By the second half of the survey after good catches had occurred, a higher tagging goal of 7,000 sablefish was established. There were several factors that may have contributed to this survey being more successful than recent past years: In 2009 we had a new vessel captain who worked closely with the ADF&G crew leader to determine set locations. In addition, a bathymetric map of the northern end of Chatham Strait to Frederick Sound was available for the first time and was used by the vessel captain and the ADF&G crew leader for set placement. A change in bait was made from past years; in 2009 we used only pollock and squid and no herring. Also we did not sample statistical area 335701 as in past years because the 2006 to 2008 catch for this area was less than 2%; this allowed us more time to concentrate on other statistical areas.

The proportion of tagged fish by depth was similar to the proportion of the 2005 to 2008 commercial harvest by depth. There was 3% or less difference between the fish tagged from a particular depth range in 2009 and the proportion of fish harvested in a particular depth range in the 2005–2008 NSEI fishery (Table 1; Table 5). During the 2009 survey, fish were tagged from the depth class of 151 to 480 fathoms and most fish in Chatham Strait were captured from depths greater than 200 fathoms (Table 5). No fish were captured and tagged from the shallowest depth classes of 50 to 150 fathoms (Table 5), which made up less than 1% of the 2005 to 2008 harvest (Table 3).

ROCKFISH RELEASE AT DEPTH

The release of rockfish at depth in order to recompress the fish was mostly unsuccessful. Release of 5 redbanded (*Sebastes babcocki*), 15 shortraker (*Sebastes borealis*), and 34 rougheye rockfish were attempted. The majority of these release attempts were unsuccessful with fish coming off the hook at or before reaching the water's surface. It is unknown how many fish were successfully recompressed. Several problems were found with the method used to release fish. First, rockfish could not be released successfully while the vessel was moving due to the line being dragged out from the stern rather than sinking down to depth. This prevented rockfish from being released during hauling of gear. As a consequence, we needed to wait until after the haul to release rockfish. During the haul, rockfish were placed in tubs of saltwater; however this proved to be a problematic method of holding rockfish because they are very buoyant due to effects of barotrauma. In the future attempts will be made to improve the holding tanks with a design that orients the fish upright, keeps their gills submerged, and circulates water over their gills. Rockfish short-term survival may decrease as the length of time to recompression increases; surface holding time has been shown to be a strong predictor of survival rate for some *Sebastes* species that have been recompressed (Jarvis and Lowe 2008). Unfortunately it is not feasible to interrupt the haul to release rockfish due to issues with longlined pot gear, so attempts to recompress fish will occur immediately after the haul in a timely fashion. Another issue was that the design of the SFD hook was not suitable for large rockfish. Large fish would bend the SFD hook and slip off before they would reach the water's surface; this problem was aggravated by the great distance of the vessel's stern to the water's surface (>10 ft). In the future we will be using a SFD hook designed to release fish up to 100lb. In addition, we used gangion line for the hand line, which easily tangled especially during hauling and was difficult to grip due to its slender diameter. We may try using groundline or a more substantial line in the future. Although, attempts to recompress rockfish in 2009 were unsuccessful, we believe that there are other methods we can explore for successful release of rockfish in future surveys.

BIOLOGICAL INFORMATION

Mid-sized to larger sablefish (660–1080 mm) composed a much greater proportion (≥67%) of the fish captured in the northern statistical area of 345803, Frederick Sound (345702), and the southern 2 statistical areas of 345631 and 345603. The 2 size classes of small to mid-sized (400–650 mm) and mid-sized to large (660–1090 mm) sablefish were represented in similar proportions in statistical area 345731 (Figure 3; Table 6). In statistical area 345701 57% of the sablefish were mid-sized to large; however, there were some sets (1, 10, 12, and 37) that were composed of a greater proportion of (≥60%) small to mid-sized sablefish. A couple of these sets (12 and 37) were located adjacent to Baranof Warm Springs.

The average length of all sablefish caught during the 2009 mark-tag survey increased from 2008, continuing a trend that has occurred since the mark-tag survey began using pot gear in 2000 (Figure 4). The average length for the 8,318 sablefish fork lengths collected in 2009 was 682 mm, an increase of 27 mm from 2008 (Stahl and Holum 2009) and 134 mm from 2000 (O'Connell and Holum 2007; Richardson 2001; Richardson 2002; Richardson 2003; Stahl and Holum 2008; *unpublished ADF&G data*). The larger average length in recent years supports the idea that sablefish recruitment in Southeast Alaska has been low (S. Dressel, ADF&G, Division of Commercial Fisheries, Douglas, *personal communication*) as observed in the Gulf of Alaska (Hanselman et al. 2008). Few strong year classes have been apparent in the Gulf of Alaska since the 1997 and 2000 year classes (Hanselman et al. 2008). Another consideration is that larger fish may be preventing smaller fish from getting into the pots. In 2009, the sablefish lengths ranged from 400 mm to 1,080 mm (Figure 5), and the length histogram exhibits a trailing tail at large lengths. This pattern is not matched at small fish lengths, possibly due to smaller fish differentially recruiting to pot gear, and fish less than 400 mm rarely recruiting to the pot gear (J. Stahl, ADF&G, *unpublished ADF&G data*; Figure 5). A total of 7,062 of the 7,070 sablefish marked[2] and tagged were sampled for fork length. The marked sablefish were representative of all fish caught on the survey (Figure 5). The average length of marked sablefish was 680 mm. Of the 706 biological samples, fork lengths were collected from 704 fish with an average length of 690 mm (Figure 6). Females had a greater average length of 716 mm compared to an average male length of 649 mm (Figure 7); females accounted for 63% of the sampled fish compared to 37% for males, similar to the sex ratio sampled in 2008 (Stahl and Holum 2009), which was 60% females to 40% males.

During the timing of the mark-tag survey (June), the majority of females sampled were mature (maturity stages 3–6) and at the early stages of preparation for the upcoming spawning season (Jan.–April)[3]. Seventy-seven percent of females were classified into a post-spawning condition (stage 5 or 6); these fish did not have eggs visible to the "naked eye". However, many of these fish probably have some yolk development in their oocytes[3]. Nine percent of females were considered to be ripe (stage 3), and none were considered to be spawning (stage 4). In addition, 3% of females were classified as immature (stage 1) and 12% as maturing juvenile (stage 2; Figure 8). Immature fish are not expected to spawn in the approaching season, but some of the maturing juvenile would be expected to spawn in the approaching season[3]. The majority of male sablefish were classified into an inactive maturity state; 58% were classified as post-spawning (stage 5 or 6) and 35% as either immature (stage 1) or maturing juvenile (stage 2). Only a small percentage of male sablefish were considered to be ripe (stage 3; 6%) and only one was considered to be spawning (stage 4; Figure 8).

[2] One fish that was tagged was not marked with a finclip.
[3] J. Stahl, ADF&G fisheries biologist, unpublished results.

TEMPERATURE DATA

Temperature was successfully measured at times and locations sablefish were exposed during capture and handling during the 2009 NSEI mark-tag survey. Bottom temperatures ranged from 4.8°C to 5.3°C varying less than 1°C over the entire survey with an average bottom temperature of 5.0°C (Figure 9). Surface temperatures ranged from 8.5°C to 13.3°C with an average of 10.5°C. Holding tank temperatures of the center tank ranged from 8.9°C to 15.7°C with an average temperature of 12.1°C. There was about a 5.5°C difference between the average surface and bottom temperatures and 7.1°C difference between the average holding tank and bottom temperatures. Surface temperatures varied 4.8°C and the holding tank temperatures 6.8°C over the entire survey, and over the course of a day, the surface and holding tank temperatures varied up to 4.8°C and 4.2°C, respectively dependent on weather conditions (Figure 8). Average bottom temperature was the same in 2009 as in 2008. However, the average surface temperature was almost 2 degrees higher in 2009 than in 2008. In spite of the difference in surface temperature between these 2 years, the holding tank temperature varied only 0.4°C between years.

There may be some inaccuracy in temperature measurements. At the beginning of the survey, a digital thermometer was used to measure the holding tank temperature until the battery died. TidbiT® v2 Temp Loggers were then employed to measure the temperature of the holding tank from June 4 to 9. A new battery for the holding tank's digital thermometer was found, and the holding tank was measured again using this thermometer from June 10 until the end of the survey. On June 10 and 11 a TidbiT® v2 Temp Logger, in addition to the digital thermometer, was used to measure temperature in the holding tanks. During these 2 days the TidbiT® v2 Temp Logger measured the temperature 2°C higher than the digital thermometer. Later testing and comparison of the TidbiT® v2 Temp Loggers with the digital thermometers indicated that the thermometers measured higher with an average up to 1.8°C higher than the TidbiT® v2 Temp Logger. Both the TidbiT® v2 Temp Loggers and the thermometers are certified for temperature measurement, so similar measurements were expected from these devices. However, the backing fell off of one of the digital thermometers during the survey and was repaired with duct tape. This temporary repair could have allowed moisture inside the unit and affected measurement capabilities. In the future damaged thermometers will not be used.

The temperature of the holding tanks was generally warmer than the surface temperature recorded. The holding tank water was usually coolest in the morning after sitting over night and then warmed up during the day. During the 2009 survey, there were some very hot and sunny days which occurred. On these days, cardboard from flattened fish boxes or pieces of plywood were used to partially cover tanks during processing. A piece of plywood fitted for the holding tanks will be obtained for future surveys. In addition, frequent flushing of the tanks occurred. All of the water from a holding tank was dumped and the tank was refilled in an attempt to maintain high oxygen levels and cool water temperatures for sablefish held in the tanks prior to tagging.

The total time required to process a pot of sablefish, including tagging, measuring, clipping, sampling, and discarding, was recorded for 36 different pots. The maximum time to process the sablefish in a pot was 513 seconds (8 minutes and 33 seconds) for 23 fish. On average it took 19 seconds to process a fish.

During the 2009 NSEI mark-tag survey, sablefish were exposed to elevated water and air temperatures for a maximum of about 8 minutes, but the minimum length of exposure that may contribute to immunological suppression is currently unknown. Sablefish captured and released

during the NSEI mark-tag survey were exposed to elevated temperatures of up to 15.7°C, approximately 10.7°C degrees higher than the bottom temperatures from which they were captured. In experiments conducted by Davis and others (2001), fish that were exposed to temperatures similar to the average temperature (12°C) observed in the holding tanks during our survey had delayed mortality after first being subjected to towing (33%). Fish from this survey may get dragged in pots that are hanging in the water while other pots are being processed on deck. During the mark-tag survey, exposure to air is minimal and limited to the time required to dump fish from pots into the holding tank and to the handling time when fish are tagged, clipped, measured, and examined.

ACKNOWLEDGEMENTS

Special thanks to the crew of the R/V *Zolotoi* for their at-sea accommodations. We are grateful to other groundfish staff for their hard work on the 2009 pot survey, including Becky Knight, Allison Sayer, and Kamala Carroll.

REFERENCES CITED

Carlile, D., B. Richardson, M. Cartwright, and V. M. O'Connell. 2002. Southeast Alaska sablefish stock assessment activities 1988–2001. Alaska Department of Fish and Game, Regional Information Report 1J02-02, Douglas.

Davis, M. W., B. L. Olla, C. B. Schreck. 2001. Stress induced by hooking, net towing, elevated sea water temperature and air in sablefish: lack of concordance between mortality and physiological measures of stress. Journal of Fish Biology 58: 1–15.

Davis, M. W. 2005. Behaviour impairment in captured and released sablefish: ecological consequences and possible substitute measures for delayed discard mortality. Journal of Fish Biology 66: 254–265.

Dressel , S. C. 2009. 2006 Northern Southeast Inside sablefish stock assessment and 2007 forecast and quota. Alaska Department of Fish and Game, Fishery Data Series No. 09-50, Anchorage.

Hanselman, D. H., C. R. Lunsford, J. T. Fujioka, C. J. Rodgveller. 2008. Chapter 3: Assessment of the sablefish stock in Alaska. Pages 303–420 [*in*] Stock assessment and fishery evaluation report for the groundfish resources of the Gulf of Alaska region. North Pacific Fishery Management Council, Anchorage.

Jarvis, E. T. and C. G. Lowe. 2008. The effects of barotrauma on the catch-and-release survival of southern California nearshore and shelf rockfish (Scorpaenidae, *Sebastes* spp.). Canadian Journal of Fisheries and Aquatic Sciences 65: 1286–1296.

Lupes, S. C., M. W. Davis, B. L. Olla, C. B. Schreck. 2006. Capture-related stressors impair immune system function in sablefish. Transactions of the American Fisheries Society 135:129–138.

O'Connell, V. and D. Holum. 2007. 2006 NSEI (Chatham Strait) tagging survey. Alaska Department of Fish and Game, Regional Information Report 1J07-04, Douglas.

Richardson, B. 2001. NSEI sablefish marking pot survey cruise report. Alaska Department of Fish and Game, Regional Information Report 1J01-38, Douglas.

Richardson, B. 2002. 2002 NSEI (Chatham) sablefish pot survey report. Alaska Department of Fish and Game, Regional Information Report 1J03-15, Douglas.

Richardson, B. 2003. 2003 NSEI (Chatham) sablefish pot survey report. Alaska Department of Fish and Game, Regional Information Report 1J03-38, Douglas.

Stahl, J. P. and D. D. Holum. 2009. 2008 NSEI (Northern Southeast Inside Subdistrict) sablefish mark-tag survey. Alaska Department of Fish and Game, Fishery Data Series No. 09-43, Anchorage.

Stahl, J.P. and D. D. Holum. 2008. 2007 NSEI (Chatham Strait) sablefish tagging survey. Alaska Department of Fish and Game, Fishery Data Series No. 08-62, Anchorage

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TABLES AND FIGURES

Table 1.–Average proportion of 2006–2008 NSEI sablefish harvest by statistical area and sablefish harvest by depth class and statistical area.

		Average proportion 2006–2008 NSEI harvest by depth class (fathoms)								
Statistical area	**Average proportion 2006–2008 NSEI harvest**	**50–100**	**101–150**	**151–200**	**201–250**	**251–300**	**301–350**	**351–400**	**401–450**	**451–480**
345603	0.12	0	0	0	0.01	0.03	0.03	0.04	0	0
345631	0.33	0	0	0	0	0.02	0.1	0.2	0	0
345701	0.34	0	0	0	0	0.03	0.15	0.09	0.05	0.02
345702	0.03	0	0	0.03	0	0	0	0	0	0
345731	0.1	0	0	0	0.01	0.05	0.04	0	0	0
345803	0.07	0	0	0	0	0.02	0.04	0.01	0	0
Percent of total		0	0	0.03	0.03	0.14	0.38	0.34	0.05	0.02

Table 2.–Sablefish maturity condition using a 6-stage scale for macroscopic examination of gonads.

Maturity code	Condition	Macroscopic examination	
		Males	**Females**
1	Immature	Testes very narrow, parallel, flat and ribbon-like, almost clear in color. Longitudinal creases are easily discernible.	Ovaries appear as 2 narrow ovoids. May be veined.
2	Maturing juvenile	Testes enlarging, not ribbon-like, with 4 discernable creases running full length. Light pink in color. Has not spawned before.	Ovaries enlarging, translucent and pinkish to clear: eggs not yet discernable. Has not spawned before. Will spawn coming year. More veined. Cloudy, but not necessarily throughout.
3	Mature/ developing	Testes large and white, each with 4 distinct lobes. No milt present.	Ovaries large and becoming white to yellowish white with developing eggs discernable and firmly attached.
4	Spawning	Testes very large and white, extruding milt freely under slight pressure or when cut.	Ovaries very large with large translucent eggs loose within ovary or extruding from the oviduct.
5	Spent/ Post spawning	Testes large, shriveled, often with wrinkles, and bloodshot. No milt present.	Ovaries shriveled and opaque, soft and flaccid, often reddish in color.
6	Resting	Testes large and firm, light brown to off-white in color. No milt present. Has spawned previously. May have wrinkles.	Ovaries large, firm and opaque, not shriveled. No eggs discernable. Has spawned previously. Noticeable follicle structure.

Table 3.–Marking goals by NSEI statistical area and depth based on a total goal of 7,000 marks and tags.

Statistical area	Number of fish to tag/mark	Number of fish to tag/mark by depth range (fathoms)								
		50–100	101–150	151–200	201–250	251–300	301–350	351–400	401–450	451–480
345603	831	1	3	7	80	206	225	309	0	0
345631	2,324	0	3	8	18	148	731	1,405	11	0
345701	2,410	1	1	6	27	189	1,083	607	360	136
345702	202	0	2	188	7	5	0	0	0	0
345731	713	0	0	3	56	339	302	13	0	0
345803	522	0	1	1	22	114	309	75	0	0
Total	7,002*	2	10	213	210	1,001	2,650	2,409	371	136

*Note—Numbers of fish to tag by depth and statistical area were rounded to whole numbers; consequently, the total adds up to 7,002 fish to tag/mark.

Table 4. –Marking goals and actual number of tagged and marked sablefish released by statistical area for the NSEI mark-tag survey, 2009.

Statistical area	Goal based on 7,000 marks and tags	Average proportion of 2006–2008 NSEI harvest	Number marked and tagged	Percent Marked and tagged
345603	829	0.12	835	0.12
345631	2,323	0.33	2,342[a]	0.33
345701	2,411	0.34	2,430	0.34
345702	202	0.03	206	0.03
345731	713	0.10	726	0.10
345803	522	0.07	532	0.08
Total	7,000		7,071	

[a] One sablefish on set 4 in statistical area 345731 was tagged but not clipped.

Table 5.–Number of sablefish marked and tagged by NSEI statistical area and depth class for a total goal of 7,000 marks/tags.

	Number of fish tagged/marked by depth class (fathoms)									
Statistical area	**50–100**	**101–150**	**151–200**	**201–250**	**251–300**	**301–350**	**351–400**	**401–450**	**451–480**	**Total**
345603	0	0	0	24	115	366	330	0	0	835
345631[a]	0	0	0	0	208	782	1,320	32	0	2,342
345701	0	0	0	8	163	1,112	686	335	126	2,430
345702	0	0	192	14	0	0	0	0	0	206
345731	0	0	0	106	183	437	0	0	0	726
345803	0	0	0	51	127	192	162	0	0	532
Total	0	0	192	195	856	2,889	2,500	367	126	7,071
Percent of total	0%	0%	3%	3%	12%	41%	35%	5%	2%	100%

[a]One sablefish on set 4 in statistical area 345731 was tagged but not clipped.

Table 6.–Proportion of sablefish captured and measured for length by length class in each statistical area for the NSEI mark-tag survey, 2009.

Statistical area	**Number 400–650 mm**	**Number 660–1080 mm**	**Proportion 400–650 mm**	**Proportion 660–1080 mm**
345603	324	653	0.33	0.67
345631	824	1,873	0.31	0.69
345701	1,222	1,596	0.43	0.57
345702	43	203	0.17	0.83
345731	422	433	0.49	0.51
345803	230	495	0.32	0.68

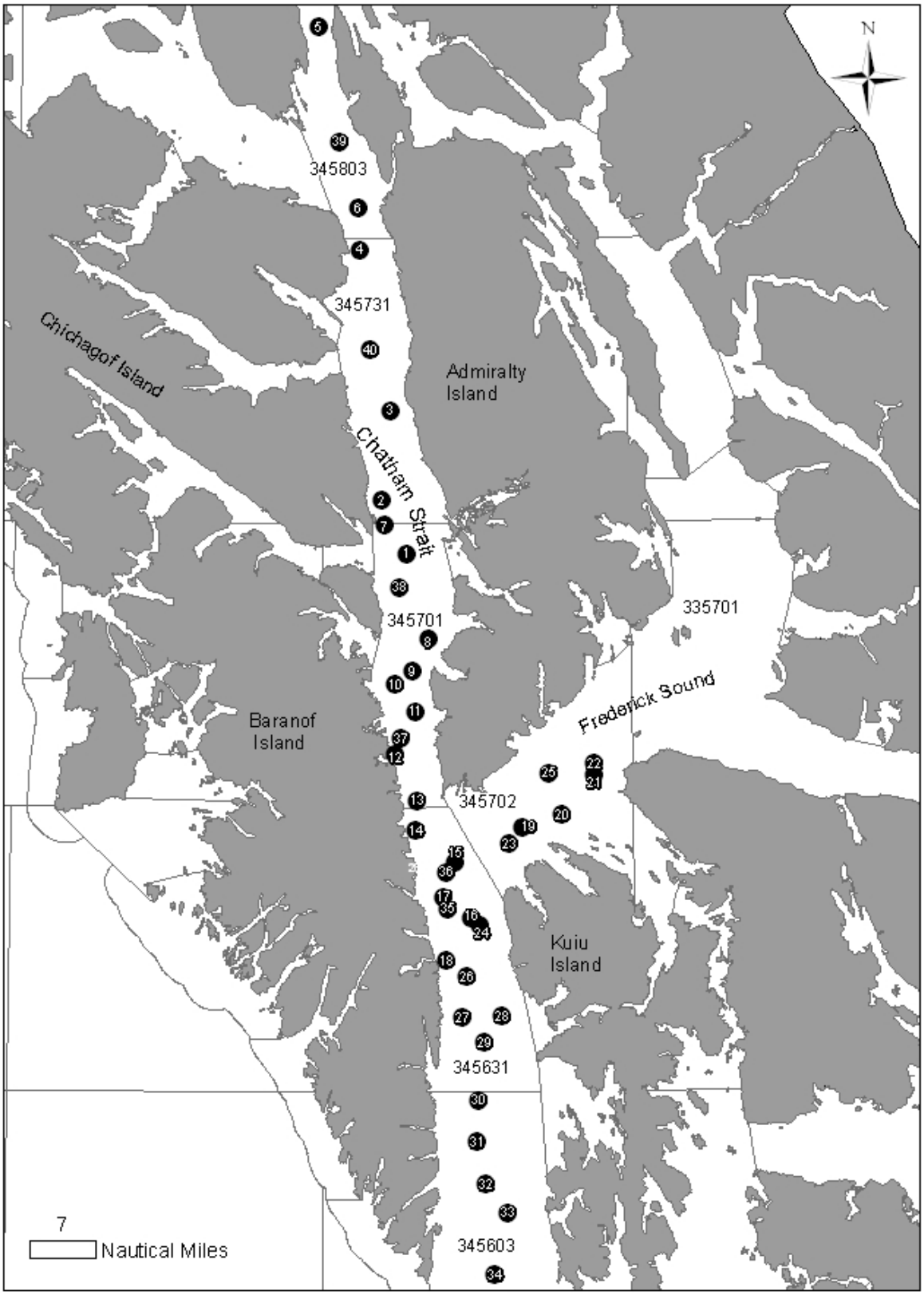

Figure 1.–Set locations for the NSEI mark-tag survey, 2009.

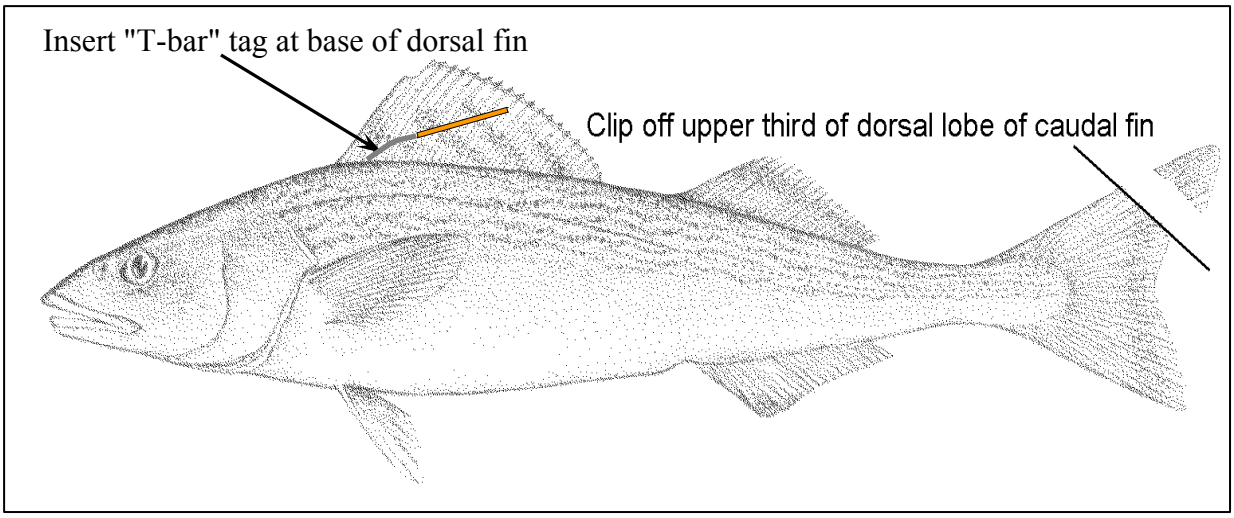

Figure 2.–Sablefish marking guidelines, NSEI mark-tag survey, 2009. Sablefish are double-marked with an upper caudal finclip and a T-bar tag.

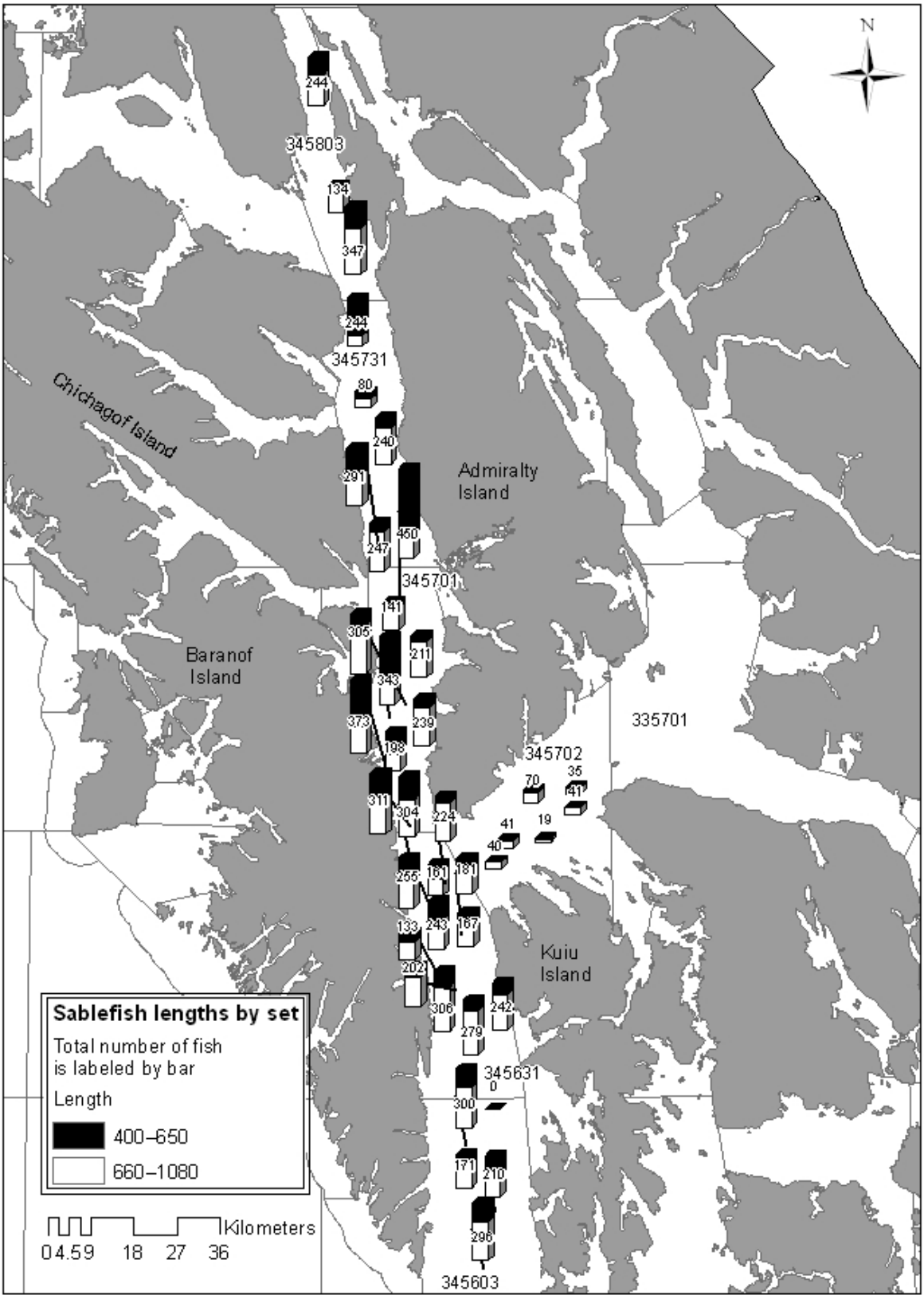

Figure 3.–Sablefish length distribution mapped by set, NSEI mark-tag survey, 2009.

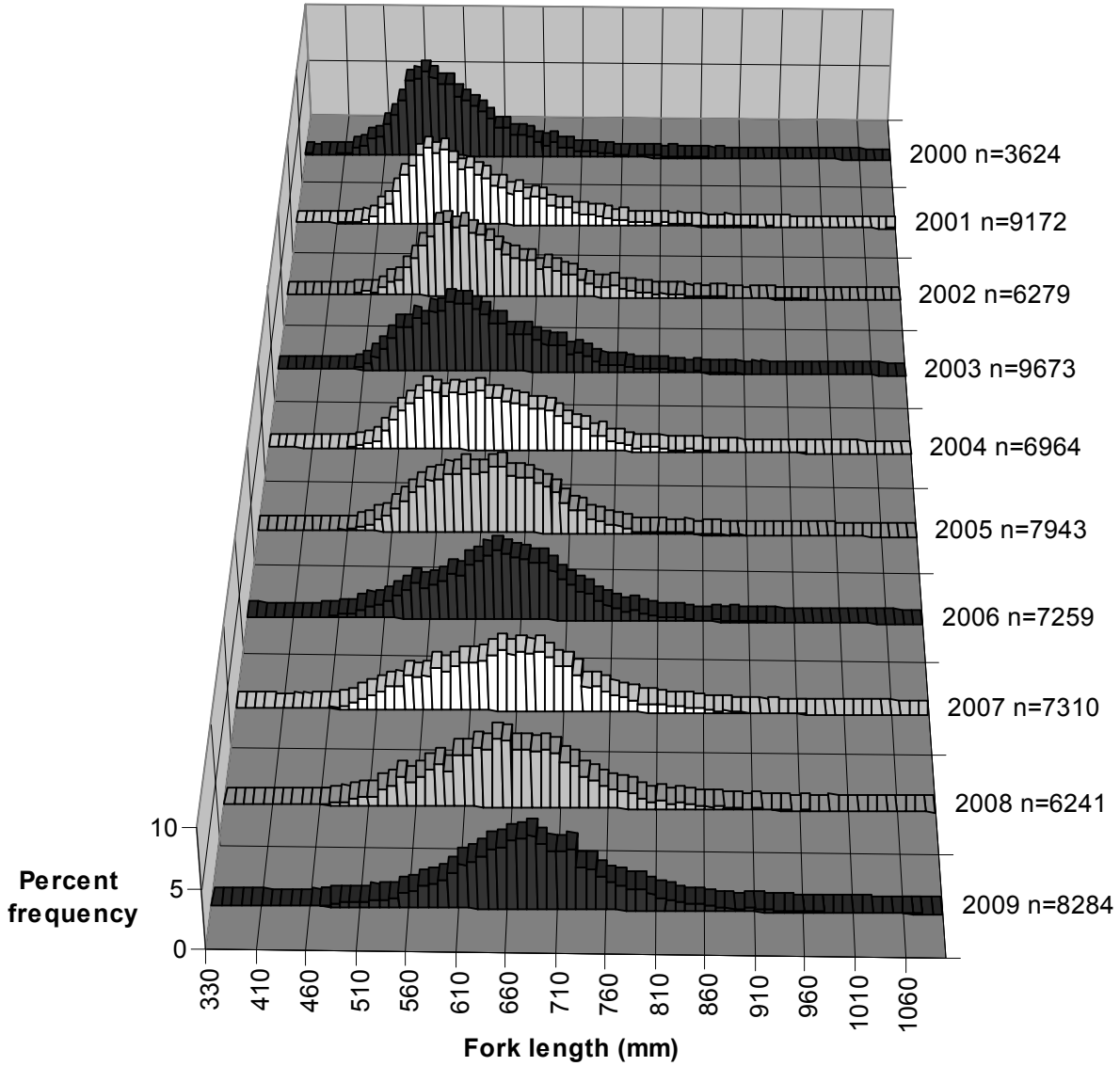

Figure 4.–Length frequency of all sablefish captured and measured during the 2000 to 2009 mark-tag surveys.

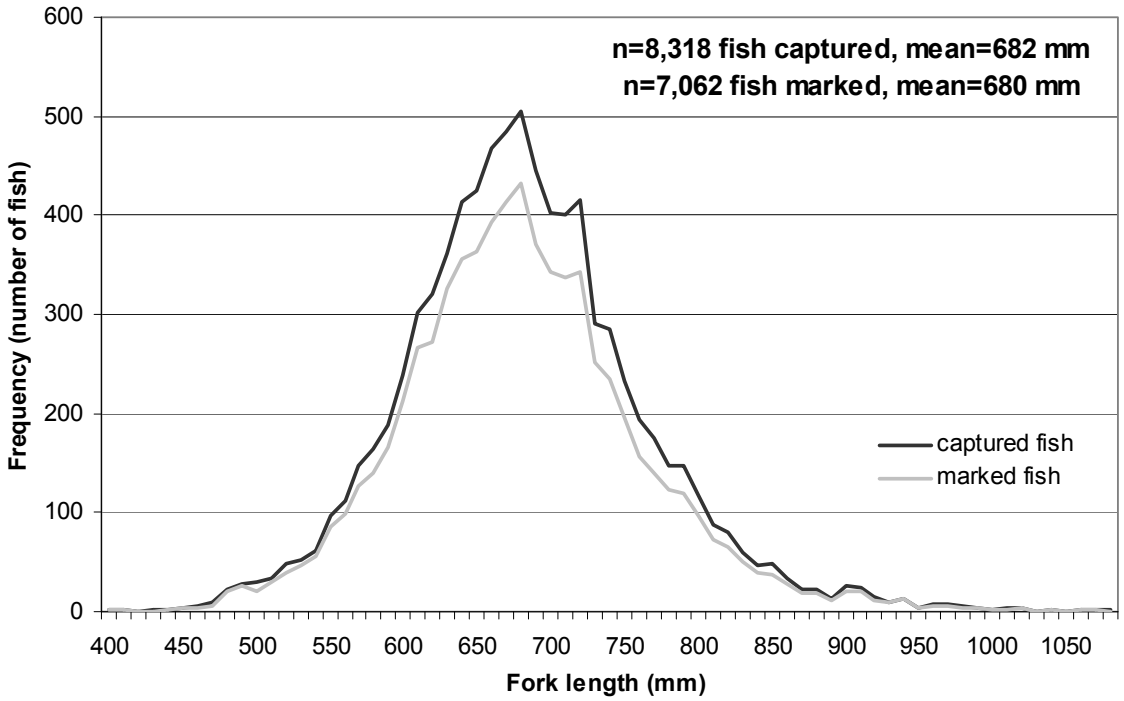

Figure 5.–Length frequency distribution for 1) all sablefish captured and sampled for length and 2) for sablefish tagged, marked, and released during the NSEI mark-tag survey, 2009.

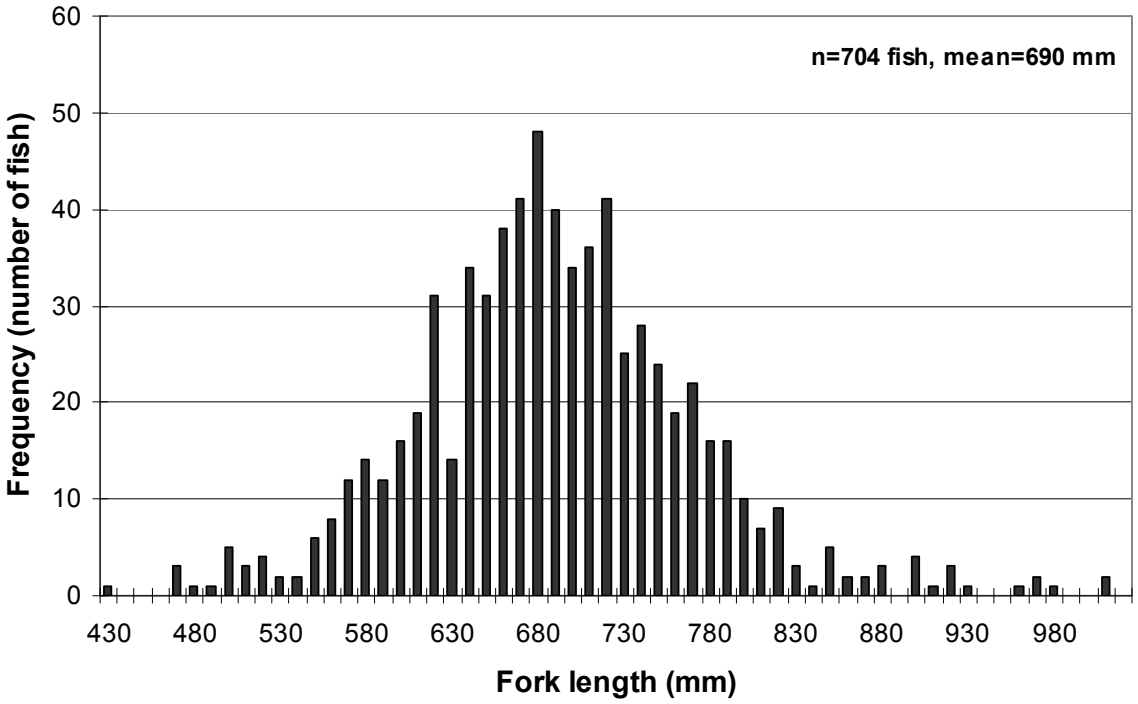

Figure 6.–Sablefish length frequency distribution for biological samples collected during the NSEI mark-tag survey, 2009.

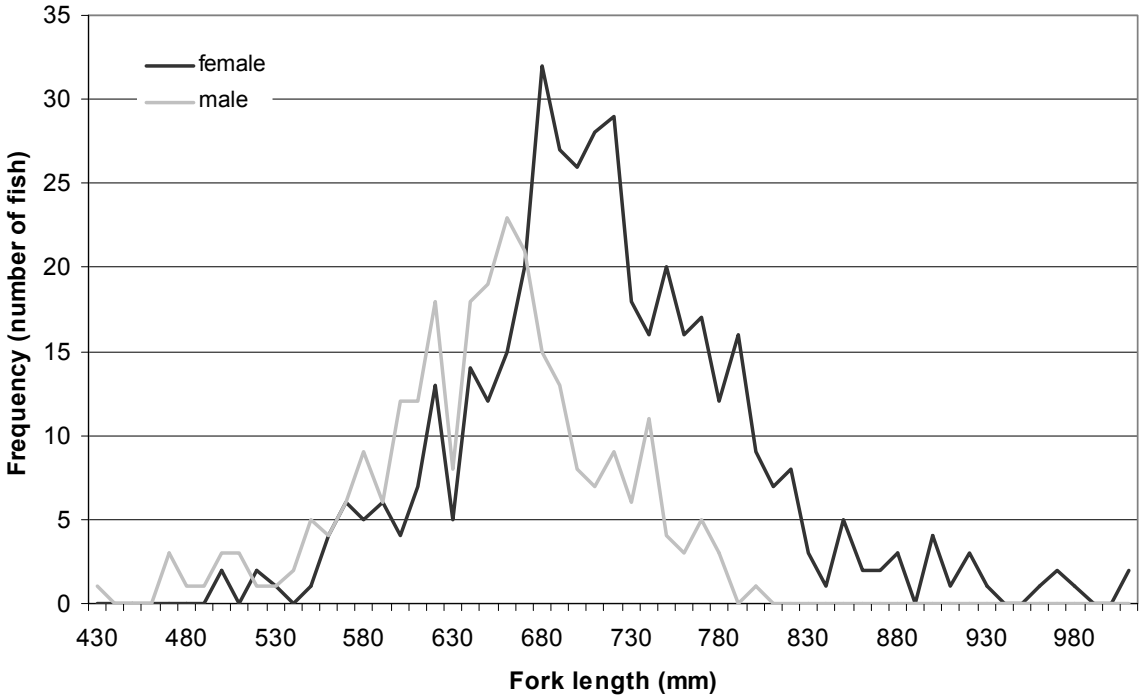

Figure 7.–Sablefish length frequency distributions, by sex, for biological samples collected during the NSEI mark-tag survey, 2009.

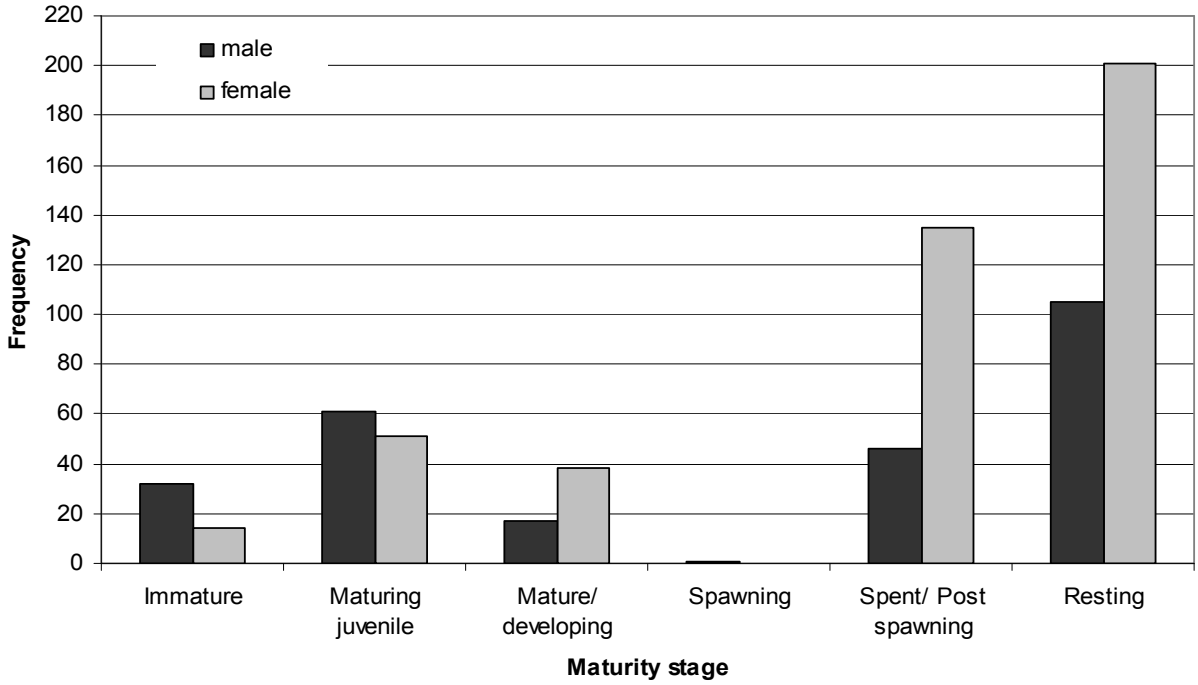

Figure 8.–Frequency of occurrence of macroscopic maturity stages, by sex, for sablefish biological samples collected during the NSEI mark-tag survey, 2009.

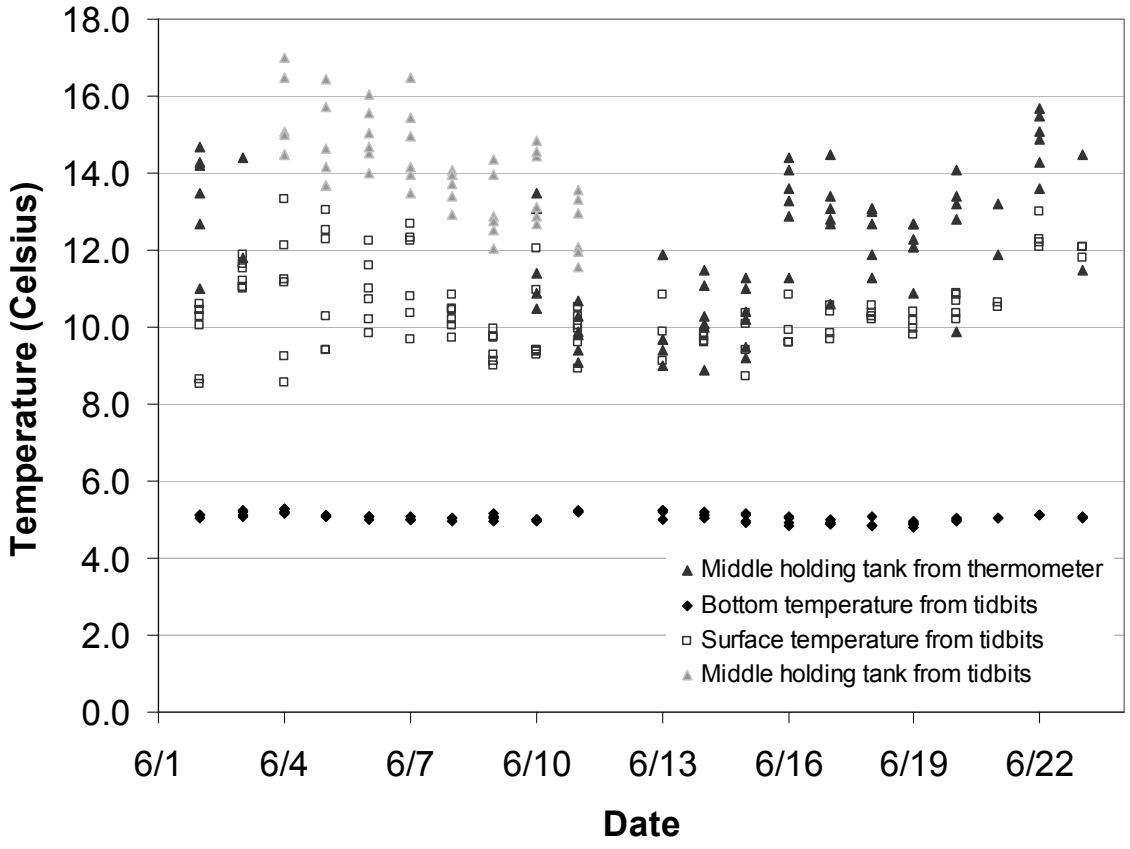

Figure 9.–Temperatures that sablefish were exposed to during their capture and handling on the NSEI mark-tag survey, 2009.

APPENDICES

Appendix A.–Crew from the R/V Zolotoi and staff from the Alaska Department of Fish and Game on the NSEI mark-tag survey, 2009 (first leg, June 1–11 and second leg, June 12–23).

Name	Position	Affiliation	Leg(s)
John Greenway	Skipper	R/V Zolotoi	Both
Bill Fenner	Deck	R/V Zolotoi	Both
Manuel Pasillas	Deck	R/V Zolotoi	Both
Andrew Higashi	Deck	R/V Zolotoi	Both
Deidra Holum	Survey leader	ADF&G	Both
Allison Sayer	Scientific staff	ADF&G	First
Kamala Carroll	Scientific staff	ADF&G	First
Rebecca Knight	Scientific staff	ADF&G	Second
Jennifer Stahl	Scientific staff	ADF&G	Second

Appendix B.–Detailed set information, including location and timing, for the NSEI mark-tag survey, 2009.

		Start				End										Depth (fm)			
Set	Stat area	Lat deg	Lat min	Long deg	Long min	Lat deg	Lat min	Long deg	Long min	Date Set	Time set	Soak time (h)	Haul time (h)	Haul direction	# Pots set	Start	End	Avg	Substrate
1	345701	57	26.76	134	43.31	57	28.85	134	42.24	6/1/09	18:13	16.60	2.58	Same	45	313	289	311	Mud
2	345731	57	32.44	134	48.10	57	34.06	134	45.77	6/1/09	19:26	20.82	2.08	Opposite	40	338	326	324	Mud/Soft
3	345731	57	41.84	134	46.34	57	39.86	134	47.10	6/2/09	13:00	20.88	2.47	Opposite	42	305	246	306	Mud/Soft
4	345731	57	58.82	134	52.25	57	56.93	134	53.71	6/2/09	20:00	19.83	2.00	Opposite	43	273	241	258	Mud/Soft
5	345803	58	22.34	135	0.52	58	20.27	135	0.30	6/3/09	19:20	13.78	2.05	Opposite	42	300	239	278	Mud/Soft
6	345803	58	3.25	134	52.67	58	1.05	134	52.47	6/3/09	13:10	24.83	2.33	Opposite	42	376	326	358	Mud/Soft
7	345701	57	29.78	134	47.68	57	27.87	134	46.93	6/4/09	18:54	13.93	1.83	Opposite	42	376	388	370	Mud/Soft
8	345701	57	17.79	134	39.02	57	19.70	134	40.06	6/4/09	20:50	17.00	0.88	Opposite	42	245	355	306	Mixed
9	345701	57	14.36	134	42.38	57	16.57	134	41.67	6/5/09	11:18	21.92	2.25	Same	42	481	401	445	Mud/Soft
10	345701	57	13.02	134	45.63	57	11.29	134	43.72	6/5/09	15:20	22.33	2.22	Opposite	42	310	372	342	Mixed
11	345701	57	10.16	134	41.80	57	12.37	134	41.55	6/6/09	10:45	22.75	2.20	Opposite	42	401	449	434	Mud/Soft
12	345701	57	5.67	134	45.75	57	4.06	134	42.28	6/6/09	15:01	24.05	2.48	Same	42	300	348	338	Mud/Soft
13	345701	57	0.70	134	41.58	57	2.71	134	41.74	6/7/09	11:48	21.42	2.02	Same	42	351	358	356	Mud/Soft
14	345631	56	57.55	134	41.78	56	55.31	134	41.92	6/7/09	16:53	20.73	1.92	Same	42	337	307	333	Mud/Soft
15	345631	56	54.21	134	34.33	56	56.39	134	35.80	6/8/09	10:58	22.07	1.68	Same	42	350	252	313	Mud/Soft
16	345631	56	48.39	134	31.18	56	49.79	134	33.59	6/8/09	15:33	21.23	1.42	Opposite	41	350	399	378	Mud/Soft
17	345631	56	50.56	134	36.65	56	52.05	134	39.50	6/9/09	10:28	24.48	1.83	Opposite	42	392	352	374	Mud/Soft
18	345631	56	43.88	134	36.02	56	45.63	134	38.23	6/9/09	14:30	26.07	1.43	Opposite	42	383	355	386	Mud/Soft
19	345702	56	57.88	134	21.35	57	0.34	134	20.19	6/10/09	12:45	19.40	1.45	Same	42	192	192	190	Mud/Hard
20	345702	56	59.14	134	13.60	56	57.36	134	17.16	6/10/09	19:30	16.25	1.23	Same	42	210	155	187	Hard
21	345702	57	3.32	134	7.34	57	1.38	134	10.21	6/11/09	9:46	46.32	1.43	Opposite	42	190	195	197	Hard
22	345702	57	4.53	134	7.16	57	7.10	134	6.28	6/11/09	12:52	50.35	1.28	Opposite	42	199	192	197	Hard
23	345702	56	56.15	134	23.86	56	58.45	134	22.20	6/13/09	17:25	14.55	1.18	Same	42	184	192	188	Mixed
24	345631	56	47.50	134	29.67	56	45.43	134	30.78	6/13/09	10:48	26.40	1.73	Opposite	42	301	370	334	Rock
25	345702	57	3.56	134	15.99	57	1.43	134	18.60	6/14/09	9:24	22.85	1.23	Same	42	196	193	195	Hard
26	345631	56	42.11	134	32.24	56	44.20	134	31.21	6/14/09	14:31	23.45	1.92	Same	42	398	354	386	Mud/Soft
27	345631	56	37.85	134	32.96	56	39.57	134	31.44	6/15/09	11:27	21.50	1.97	Opposite	42	355	385	368	Hard
28	345631	56	37.99	134	25.62	56	39.96	134	28.24	6/15/09	15:36	21.18	1.63	Same	42	272	327	297	Hard

-continued-

		Start				End										Depth (fm)			
Set	Stat area	Lat deg	Lat min	Long deg	Long min	Lat deg	Lat min	Long deg	Long min	Date Set	Time set	Soak time (h)	Haul time (h)	Haul direction	# Pots set	Start	End	Avg	Substrate
29	345631	56	35.22	134	28.82	56	33.24	134	30.41	6/16/09	10:05	22.78	1.80	Same	42	292	348	332	Hard
30	345603	56	29.11	134	29.98	56	31.03	134	31.69	6/16/09	14:40	22.83	1.38	Same	42	375	353	365	Hard
31	345603	56	24.74	134	30.38	56	23.08	134	28.63	6/17/09	11:05	21.82	2.08	Same	41	350	398	383	Mud/Hard
32	345603	56	20.24	134	28.83	56	22.30	134	30.59	6/17/09	15:17	21.63	1.50	Opposite	42	366	244	316	Mud/Hard
33	345603	56	17.26	134	24.64	56	19.24	134	23.36	6/18/09	10:34	21.50	1.55	Same	42	396	244	332	Hard
34	345603	56	10.73	134	27.20	56	12.72	134	25.55	6/18/09	15:07	20.08	1.77	Same	42	338	244	321	Mud/Hard
35	345631	56	49.35	134	35.80	56	47.45	134	34.34	6/19/09	16:09	16.80	1.77	Same	42	392	396	397	Mud/Soft
36	345631	56	53.20	134	35.86	56	51.45	134	34.91	6/19/09	17:24	18.82	1.50	Same	42	364	378	372	Mud/Soft
37	345701	57	7.30	134	44.49	57	5.41	134	42.66	6/20/09	14:52	18.05	1.73	Opposite	42	335	351	340	Mud/Soft
38	345701	57	23.22	134	44.82	57	25.18	134	45.95	6/21/09	12:09	20.12	1.78	Opposite	42	301	353	339	Mud/Soft
39	345803	58	10.24	134	56.26	58	12.34	134	56.01	6/22/09	13:29	7.60	1.45	Opposite	42	349	324	332	Mud/Soft
40	345731	57	48.25	134	50.47	57	50.36	134	49.13	6/23/09	6:41	5.03	1.57	Opposite	42	300	251	274	Mud/Soft

Appendix C.–Species caught and identified during the NSEI mark-tag survey, 2009.

Common name	**Scientific name**
Sablefish	*Anoplopoma fimbria*
Rougheye rockfish	*Sebastes aleutianus*
Shortraker rockfish	*Sebastes borealis*
Redbanded rockfish	*Sebastes babcocki*
Shortspine thornyhead rockfish	*Sebastolobus alascanus*
Arrowtooth flounder	*Atheresthes stomias*
Pacific halibut	*Hippoglossus stenolepis*
Dover sole	*Microstomus pacificus*
Pacific sleeper shark	*Somniosus pacificus*
Pacific cod	*Gadus macrocephalus*
Golden (brown) king crab	*Lithodes aequispina*

Appendix D.–Fish captured by set for the NSEI mark-tag survey, 2009.

	Groundfish						Sharks	Rockfish				
Set	Sable-fish	Pacific cod	Arrow-tooth flounder	Pacific halibut	Dover sole	Unknown general ground-fish	Pacific sleeper shark	Thorny-head	Rough-eye	Short-raker	Red-banded	Total
1	452		37	6	1			2	1			499
2	291		13	3	5			3				315
3	373		4	6	1			2	1			387
4	533		2	4								539
5	285		5	6	3							299
6	347		4	5		1		1				358
7	247		21	1	11			3				283
8	211		7	10	4			2				234
9	305			1	6	1		1				314
10	501		13	1	7			1				523
11	239		17		21	1		2				280
12	373		35	4	19		1	6				438
13	311		20	3	47			1				382
14	304		34	3	24	1		1				367
15	225		22	10	13			2	3	1		276
16	182		22	1	11			2				218
17	255		41	12	99			5				412
18	133		48	9	58			5				253
19	42	3	124	49	10				8		3	239
20	19	3	123	31				3	16	1	2	198
21	41		161	25	6			2	42		3	280
22	35		104	31	2	5			21		1	199
23	40	1	57	21	1				20		1	141
24	167		37	1	5		1	2		2		215
25	70		48	33	3				18			172
26	202		32	9	25			5				273

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	Groundfish						Sharks	Rockfish				
Set	Sable-fish	Pacific cod	Arrow-tooth flounder	Pacific halibut	Dover sole	Unknown general ground-fish	Pacific sleeper shark	Thorny-head	Rough-eye	Short-raker	Red-banded	Total
27	306		25	9	27							367
28	242		50	3	8				1			304
29	280		8		2			1		2		293
30	138											138
31	300		67		10			5				382
32	171		92		2			1		7		273
33	211		57	4	5			3	1	5		286
34	296		58					1		1		356
35	244		31		46			7				328
36	299		24		8			3				334
37	288		23	2	21			3				337
38	227		1		12			2				242
39	197											197
40	390			1								391
Total	9,772	7	1,467	304	523	9	2	77	132	19	10	12,322

Appendix E.–Numbers of sablefish marked, released, retained, or discarded by set for the NSEI mark-tag survey, 2009.

	Released			Retained		Discarded			
Set	Tagged & marked[a]	Previously tagged by ADF&G	Clipped only	Previously tagged by other agency	Biological sample	Sand fleas	Not marketable	Numbers estimated	Total
1	398	14		1	37		2		452
2	257	2			24	8			291
3	209	2			21	8	2	131	373
4	203	2			21	14	5	288	533
5	210				20	12	2	41	285
6	221	2			29	94	1		347
7	222	1	1		20	3			247
8	191	1			18	1			211
9	264	1			26	13	1		305
10	301	6		1	29	4	3	157	501
11	197	3			20	13	6		239
12	333	4			31	4	1		373
13	263	3			28	5	12		311
14	265	6			25	1	7		304
15	197				19		9		225
16	160	1			16		5		182
17	224	6			21	1	3		255
18	119	1			12		1		133
19	37				4		1		42
20	16	1			2				19
21	33	1			4	1	2		41
22	31	1			3				35
23	35	1			4				40
24	147				14		6		167
25	54				6		10		70
26	167	4			17	1	13		202
27	270	1			26		9		306
28	212	2			20		8		242
29	249				24		7		280
30								138	138
31	256	3			26		15		300
32	148				15		8		171

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	Released			Retained		Discarded			
Set	Tagged & marked[a]	Previously tagged by ADF&G	Clipped only	Previously tagged by other agency	Biological sample	Sand fleas	Not marketable	Numbers estimated	Total
33	185	1			18	1	6		211
34	246	2			25		23		296
35	198	13	1		21		11		244
36	134	1			13		13	138	299
37	150	9			17	1	22	89	288
38	111				12		18	86	227
39	101	1			11		21	63	197
40	57	2			7	1	13	310	390
Total	7,071	98	2	2	706	186	266	1,441	9,772

[a] One sablefish on set 4 was tagged but not marked.